

Chapter II

PROPOSED ACTION AND ALTERNATIVES



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I. Introduction

The Colorado River Storage Project (CRSP) Act authorized the Navajo Unit (Navajo Dam and Reservoir) to regulate the flow of the San Juan River to make it possible for Upper Basin States to consistently use their Upper Colorado River Basin Compact (Compact) apportionments. The components of the Compact apportionment for New Mexico and Colorado supported by the Navajo Unit include the San Juan-Chama Project, the Navajo Indian Irrigation Project (NIIP), portions of the Jicarilla Apache Nation water settlement, and development of the Animas-La Plata Project (ALP Project) as well as numerous smaller water uses, both existing and proposed. The Navajo Unit provides benefits of river regulation, flood control, recreation, fish and wildlife uses, and generation of hydroelectric power.

From 1962 until 1991, Navajo Dam was operated to maximize water storage and minimize flow variation in the river below the dam. Such operation reduces the magnitude of peak spring flows and supplements flows in other seasons. The difference between this operation and the historical pre-dam hydrograph is depicted in figure II-1, which shows the 1930-62 pre-dam hydrograph, the 1973-91 historical operation post-dam hydrograph (representing the period of dam operations from 1973 to the beginning of the endangered fish test releases in 1992), and the 1992-2001 period, which reflects modifying releases to mimic a natural hydrograph.

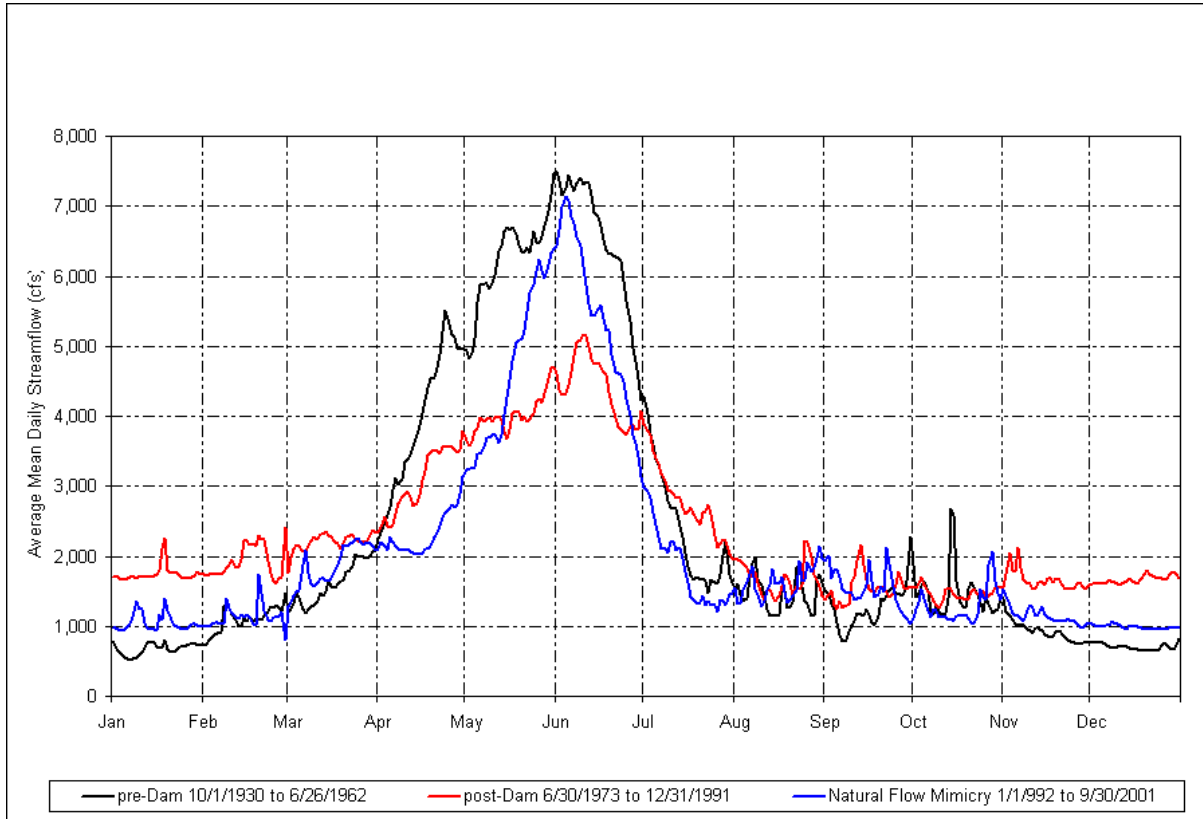


Figure II-1.—San Juan River near Bluff, Utah – U.S. Geological Survey average daily flow (compares pre-dam, post-dam, and natural flow mimicry hydrographs).

II. Alternatives Formulation

Formulation and Evaluation Criteria

The range of alternatives developed for this DEIS was initially formulated and subsequently evaluated using hydrologic modeling and the following criteria:

- ☐ Authorized purposes of the Navajo Unit
- ☐ Goals of the San Juan River Basin Recovery Implementation Program (SJRBRIP) as described in chapter I
- ☐ The *Flow Recommendations for the San Juan River* (Flow Recommendations) (Holden, 1999)

- ☐ Public scoping meetings and informal public contacts
- ☐ Coordination with cooperating agencies and interagency consultations
- ☐ Flood control procedures for Navajo Dam established with the Corps of Engineers (Corps) to provide flood protection for areas along the San Juan River from the dam to Farmington, New Mexico
- ☐ Authorized and potential American Indian (Indian) and non-Indian water uses, including those pursuant to Indian water rights and Federal trust responsibilities to Tribes and Tribal nations, water contracts with the Secretary of the Interior for delivery of the Navajo Reservoir water supply, and compact apportionments
- ☐ Applicable water rights, laws, treaties, interstate compacts, court decrees, Indian trust responsibilities, and various rules, regulations, policies, and directives

Also taken into account in formulating the alternatives were such issues as water user concerns that high releases could wash out existing water diversion structures, while low releases might make it difficult to divert water. Other concerns centered on water quality, erosion, and minimizing adverse impacts of alternative dam operations on fish and wildlife, recreation, and hydropower generation benefits.

III. Alternatives Development

Introduction

Navajo Dam was operated for SJRBRIP test studies starting in 1992. The studies resulted in the Flow Recommendations and provided information for alternative development as required under the National Environmental Policy Act (NEPA). Additional studies included:

- ☐ In November 1996, Reclamation began a 4-month low flow test to evaluate the effects of a 250 cubic feet per second (cfs) dam release during the winter months on downstream affected resources. (A detailed Winter Low Flow Test report is available from Reclamation offices in Grand Junction and Durango, Colorado (Reclamation, 1998))
- ☐ In July 2001, Reclamation conducted a 7-day low flow test to evaluate impacts of a 250 cfs release from the dam during the summer months on the tailwater trout fishery, water diversions, water quality, recreation, and other affected resources (*Summer Low Flow Test Report*, Reclamation 2002b)

For this DEIS, the following seven alternatives were developed¹:

No Action Alternative

- ☐ No Action Alternative (Historical Operation)

Action Alternatives

- ☐ 250/5000 Alternative (Flow Recommendations)
- ☐ 500/5000 Alternative
- ☐ 250 Variable/5000 Alternative
- ☐ 250/6000 Alternative
- ☐ 500/6000 Alternative
- ☐ Decommission and Breach Navajo Dam

Some of the above alternatives were subsequently eliminated prior to a more detailed evaluation, as explained later in this chapter.

IV. Alternatives Description

Introduction

This section provides a description of the seven alternatives. Each of the alternatives is described in terms of its operating parameters. The effects of implementing each alternative are summarized later in this chapter.

No Action Alternative

The No Action Alternative is defined to represent, as nearly as possible, the historical operation of the dam after initial filling in 1973 until the beginning of test releases in 1991, while taking into consideration water developments that occurred between dam construction and 1991 (for example, initial development of NIIP). These operations were

¹ The action alternatives' titles refer to their minimum/maximum release range expressed in cfs; for example, the 250/5000 Alternative has a minimum release of 250 cfs and a maximum release of 5,000 cfs.

judged to be the best representation of conditions that would be expected to occur in the future with no action taken to mimic a natural hydrograph downstream of Farmington. This alternative forms the basis against which impacts of the various action alternatives are evaluated, as required by NEPA.

Under this alternative, Navajo Dam and Reservoir would be operated essentially as it was from 1973 through 1991, with minimum releases of about 500 cfs and maximum controlled releases up to about 5,000 cfs.² Navajo Dam would not be operated to mimic a natural hydrograph below Farmington to meet Flow Recommendations criteria; thus, the No Action Alternative does not simply represent a continuation of existing conditions, but it would represent a continuation of conditions from 1973 to 1991 (historical period). Generally, flows at Archuleta, New Mexico, throughout the entire year would rarely exceed 3,000 cfs and the norm would be 1,000 to 2,000 cfs. The operational goal from 1973-1991—to store as much water in the reservoir as possible and maintain uniform flows downstream of the dam—is assumed to occur under the No Action Alternative conditions.

The No Action Alternative was analyzed using the depletion of 667,313 acre-feet per year as identified in table II-1 which cites depletions for the three alternatives retained for further analysis. Depletions are estimates of actual San Juan River Basin (Basin) water consumed by various uses.

Action Alternatives

When compared to the No Action Alternative, the action alternatives are intended to mimic a natural hydrograph below Farmington with higher spring releases and lower releases at other times of the year. Based on the Flow Recommendations, two action alternatives were initially developed. The two alternatives had the same minimum release of 250 cfs, with maximum releases of 5,000 and 6,000 cfs, respectively.

The Flow Recommendations contain recommended operating criteria for Navajo Dam, providing examples of the ways in which Navajo Dam might be operated within the limits of the specified minimum and maximum release rates to mimic a natural hydrograph. However, while evaluation of the action alternatives in this DEIS considers such operational parameters as examples, the action alternatives retain flexibility as to the amount and timing of releases within the boundaries set by the minimum and maximum release rates.

Reclamation used input from several public meetings in 1999 (as detailed in chapter V), at which time the No Action Alternative and the 250/5000 and 250/6000 Alternatives were

² Under extremely high inflow conditions, total releases plus spillway use could exceed the proposed 5,000-cfs maximum release.

Table II-1.—Summary of San Juan River Basin depletions for each alternative^{1, 2, 3}

Depletion category	No Action Alternative (acre-feet/year)	250/5000 Alternative (acre-feet/year)	500/5000 Alternative (acre-feet/year)
New Mexico depletions			
Navajo lands irrigation depletions			
Navajo Indian Irrigation Project	⁴ 143,600	⁴ 280,600	⁴ 280,235
Hogback	26,163	⁵ 12,100	⁵ 12,065
Fruitland	10,233	⁵ 7,898	⁵ 7,898
Cudei	900	900	900
Chaco River offstream depletion	⁶ 2,832	⁶ 2,832	⁶ 2,832
Whiskey Creek offstream depletion	⁶ 523	⁶ 523	⁶ 523
Subtotal	184,252	304,853	304,454
Non-Navajo lands irrigation depletions			
Above Navajo Dam – private	738	738	738
Above Navajo Dam – Jicarilla	2,190	2,190	2,190
Animas River	36,711	36,711	36,711
La Plata River	9,739	9,739	9,739
Upper San Juan	9,137	9,137	9,045
Hammond Area	10,268	10,268	10,164
Farmers Mutual Ditch	9,532	9,532	9,532
Jewett Valley	3,088	3,088	3,088
Westwater	110	110	110
Subtotal	81,513	81,513	81,318
Total New Mexico irrigation depletions	265,765	386,366	385,773
Non-irrigation depletions			
Navajo Reservoir evaporation	29,209	27,428	26,274
Utah International	39,000	39,000	38,981
San Juan power plant	⁷ 16,200	⁷ 16,200	⁷ 16,200
Industrial diversions near Bloomfield	2,500	2,500	2,500
Municipal and industrial uses	8,454	8,454	8,432
Scattered rural domestic uses	⁶ 1,400	⁶ 1,400	⁶ 1,400
Scattered stock ponds and livestock uses	⁶ 2,200	⁶ 2,200	⁶ 2,200
Fish and wildlife	⁶ 1,400	⁶ 1,400	⁶ 1,400
Total New Mexico non-irrigation depletions	100,363	98,582	97,387
San Juan-Chama Project exportation	107,514	107,514	107,514
Unspecified minor depletions	⁸ 1,500	⁹ 4,500	⁹ 4,486
Animas-La Plata Project	0	13,600	13,600
Total New Mexico depletions	475,142	610,562	608,760

Table II-1.—Summary of San Juan River Basin depletions for each alternative^{1, 2, 3} (continued)

Depletion category	No Action Alternative (acre-feet/year)	250/5000 Alternative (acre-feet/year)	500/5000 Alternative (acre-feet/year)
Colorado depletions			
Upstream of Navajo Reservoir			
Upper San Juan	10,858	10,858	10,858
Navajo-Blanco	7,865	7,865	7,865
Piedra	8,098	8,098	8,098
Pine River	71,671	71,671	71,671
Subtotal	98,492	98,492	98,492
Downstream of Navajo Reservoir			
Florida	28,607	28,607	28,607
Animas	25,113	25,113	25,113
La Plata	13,049	13,049	13,049
Mancos	19,530	19,532	19,532
McElmo Basin imports	(11,769)	(11,769)	(11,769)
Subtotal	74,530	74,532	74,532
Animas-La Plata Project	0	43,533	43,523
Total Colorado depletions	173,021	216,557	216,546
Colorado and New Mexico combined depletions	648,163	827,119	825,306
Utah depletion	^{6, 10} 9,140	^{6, 10} 9,140	^{6, 10} 9,140
Arizona depletion	⁶ 10,010	⁶ 10,010	⁶ 10,010
Grand total	667,313	846,269	844,456

¹ The State of New Mexico does not necessarily agree with the depletions shown in terms of constituting evidence of actual water use, water rights, or water availability under the Compact. The SJRB RIP Hydrology Committee uses a hydrology model disclaimer that reads in part, "The model data methodologies and assumptions do not under any circumstances constitute evidence of actual water use, water rights, or water availability under Compact apportionments and should not be construed as binding on any party."

² The New Mexico Interstate Stream Commission (NMISC) and the San Juan Water Commission (SJWC) believe there are inconsistencies in depletion calculations (communications from NMISC and SJWC dated April 3 and March 21, 2002, respectively).

³ It should be noted that full development of State compact water and Indian trust water is not included in this table. Only existing projects and projects with Endangered Species Act and NEPA compliance are included in the depletion table.

⁴ Includes 10,600 acre-feet/year of annual groundwater storage. At equilibrium, the No Action Alternative drops to 133,000 acre-feet/year and the Action Alternatives drop to 270,000 acre-feet/year. 10,600 acre-feet/year for the No Action Alternative is probably overstated.

⁵ Accounts for 16,420 acre-feet/year transferred from Hogback, including the Hogback Extension, and Fruitland Projects to NIIP.

⁶ Indicates offstream depletion accounted for in calculated natural gains

⁷ Water contract with the Jicarilla Apache Nation (Public Service of New Mexico)

⁸ 1,500 acre-feet/year of depletion from minor depletions approved by SJRB RIP in 1992.

⁹ 3,000 acre-feet/year of depletion from 1999 Inter-Service consultation, a portion of which may be in Colorado.

¹⁰ 1,705 acre-feet/year San Juan River depletion, 7,435 acre-feet/year offstream depletion.

presented. Based on suggestions from public meetings and cooperating agencies, four additional alternatives were formulated: 250 Variable/5000, 500/5000 and 500/6000 Alternatives, and Decommissioning and Breaching Navajo Dam.

250/5000 Alternative (Flow Recommendations)

This alternative is designed to enable water development to proceed and to meet the Flow Recommendations for the San Juan River below Farmington. Navajo Dam would be operated so that releases range from 250 cfs to 5,000 cfs and flexibility would be retained to adjust release rates within this range to respond to new information as it becomes available. There are some restrictions on when maximum and minimum releases can occur; typically, the dam would have a release pattern to mimic a natural hydrograph in the San Juan River below Farmington with high spring flows and low-stable base flows during the non-snowmelt runoff period. All Flow Recommendations criteria can theoretically be met under this operations alternative. In the future, if Flow Recommendations change in response to SJRBRIP adaptive management (subsequently discussed), operating criteria may be adjusted.

For this alternative, a spring peak release of 5,000 cfs is planned for most years (approximately 70 percent) to meet the Flow Recommendations criteria. The summer, fall, and winter releases support a target flow in the San Juan River downstream of Farmington of 500 to 1,000 cfs for endangered fish habitat and are also designed to conserve water for spring releases and for water development. The summer, fall, and winter flow target would require releases as low as 250 cfs. If high reservoir inflows occur during the summer and the reservoir content is high, water would be released in brief peaks in the fall and winter to avoid an uncontrolled spill.³

The 250/5000 Alternative was analyzed using the same water depletions as were used in the No Action Alternative, and it assumes the following additional depletions: 57,100 acre-feet per year for the ALP Project, 120,600 acre-feet per year for completion of the NIIP, and 3,000 acre-feet per year⁴ for minor depletions defined in other Endangered Species Act (ESA) consultations. Depletions under this alternative total approximately 846,270 acre-feet per year, or about 179,000 acre-feet per year⁵ greater than the total depletion under the No Action Alternative.

³ To date Navajo Dam has spilled only one time and that was to test the spillway.

⁴ An additional 1,500 acre-feet of depletions approved by SJRBRIP in 1992 might also be at jeopardy. However, the impact of the additional 1,500 acre-feet is not considered substantial in this analysis.

⁵ The total depletion increase of 179,000 acre-feet/year includes a 1,700 acre-foot reduction in reservoir evaporation.

500/5000 Alternative

This alternative is similar to the 250/5000 Alternative, except that Navajo Dam releases would not fall below 500 cfs. The general Navajo Dam operation criteria outlined in the Flow Recommendations would be followed, with the exception of the minimum release.

Total depletions associated with this alternative are 844,456 acre-feet per year, an amount assumed to be the same as that under the 250/5000 Alternative, except that Navajo Reservoir evaporation losses are less and some water shortages would occur in dry years, resulting in about 2,000 acre-feet/year less total depletion on average. While depletions similar to those of the 250/5000 Alternative are assumed for the analysis in this DEIS, it should be noted that reconsultation under the ESA may be required on water projects that depend on the re-operation of Navajo Dam for their biological opinions.

250 Variable/5000 Alternative

The 250 Variable/5000 Alternative would maintain the same 5,000 cfs maximum release from the dam, but would allow the minimum release to vary between 250 and 500 cfs, depending on conditions throughout the year and needs of various resources. This alternative was developed to reduce impacts from the 250 cfs minimum flow on downstream resources and water users. This alternative was formulated and analyzed with April through October releases at or above 400 cfs and November through March releases as low as 250 cfs. Water depletions would be maintained at the same level as those of the 250/5000 Alternative.

250/6000 and 500/6000 Alternatives

These two alternatives would be configured in the same way as were the action alternatives above, except that the spring peak release would be increased to 6,000 cfs. Water depletions would be maintained at the same level as those for the 250/5000 Alternative. The increase of the maximum Navajo Dam release rate to 6,000 cfs was suggested as an alternative because the Flow Recommendations indicated that this maximum release rate would result in more frequently meeting the desired duration and magnitude of flows below Farmington during the spring runoff period.

Decommission and Breach Navajo Dam

This alternative would require decommissioning and physically breaching the dam, allowing the pre-dam hydrograph to be largely restored and providing endangered fish species access to the river upstream of the dam, if other barriers to fish passage were also removed.

Characteristics Common to Action Alternatives

Interim Operation

The two action alternatives retained for further analysis include the assumption that all the water uses listed in the depletion table (table II-1) are fully developed and utilized. In reality, there would be an interim period before this level of demand actually occurred (the interim period is the time until the ALP Project and NIIP are fully operational along with 3,000 acre-feet of minor unspecified water depletions). Additional operational flexibility may exist to provide supplemental flows for various purposes in this interim period as a result of these unutilized depletions.

Participation in SJRBRIP

Reclamation's participation in the SJRBRIP includes:

- ☐ Providing substantial technical support in the development, refinement, ongoing maintenance, and use of a comprehensive hydrology model for the Basin to allow realistic, supportable projections of future hydrologic conditions under various water development scenarios
- ☐ Participating in activities of the coordination, hydrology, and biology committees
- ☐ Continuing to optimize operating rules criteria for Navajo Dam and Reservoir to provide more efficient implementation of Flow Recommendations criteria, or a reasonable alternative to the Flow Recommendations, to assist in recovering endangered fish species and in making water available for further development in the Basin
- ☐ Constructing facilities to restore fish passage and support stocking plans

Reclamation will also do the following:

- ☐ Continue to conduct three Navajo Reservoir operations meetings annually to solicit input and concerns on planned operations
 - ☐ Operate the Durango Pumping Plant of the ALP Project to limit pumping during dry years, allowing more water to be kept in storage in Navajo Reservoir during the dry years where it can be used to meet water development project demands, instead of being released to meet flow statistics or targets in the San Juan River below Farmington
 - ☐ Continue to work with all Tribes/Nations in the Basin to combine resources in evaluating options for proceeding with future water development, including the
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Navajo-Gallup Project, the Jicarilla Apache Nation Navajo River Water Development Plan, restoration of the Hogback Project, and development of up to approximately 38,000 acre-feet per year direct diversions provided for in the Colorado Ute Settlement Act that are not a part of the ALP and Dolores Projects

Adaptive Management

The SJRBRIP includes an adaptive management process which includes monitoring and periodic evaluation of data to determine success of Flow Recommendations and other recovery actions. As a result, the Flow Recommendations may be adjusted as additional information becomes available through monitoring and research. Reclamation would consult with the U.S. Fish and Wildlife Service (Service) before implementing any SJRBRIP proposed modifications to the Flow Recommendations, or before implementing any proposed changes to dam operations that may be made at any of the three annual Navajo Reservoir operations meetings.

Emergency/Unforeseen Conditions

While there is a maximum release target specified for each alternative, the potential always exists for Navajo Reservoir to spill due to high reservoir levels and very high inflow. These circumstances would result in flows higher than 5,000 cfs immediately downstream from the dam under each alternative. In addition, emergencies, unforeseen conditions, and significant dam maintenance activities may occur under all alternatives, leading to changes in releases described in this DEIS. Such conditions are common to all alternatives.

Endangered Fish Releases

Reclamation is exploring whether a memorandum of agreement to protect Navajo Reservoir endangered fish releases from being diverted is necessary among Reclamation, the State of New Mexico, and the Service. This agreement would provide the mechanism to administer and protect releases of storage water from Navajo Reservoir, past intervening appropriators, to and through the endangered species habitat reach of the San Juan River.

Variables Inherent in the Operation of Navajo Dam

A number of variables common to the action alternatives may affect the ability to maintain any prescribed pattern of releases from Navajo Dam. They include the following:

1. ***Inflow forecasts:*** Forecasting techniques may not accurately predict actual snowpack levels and available runoff. If the actual inflow is higher or lower than

the projected inflow, a water surplus or shortage would occur. Each alternative would pass inflows required for downstream senior direct flow water rights according to New Mexico State water law.

2. ***Fluctuations in Animas River contributions:*** Flows from the Animas River have a significant effect on attempts to meet Flow Recommendations downstream from Farmington. The Animas, like any unregulated river, experiences a wide range of flows due to snowmelt and rain events. Trying to match Navajo Dam releases with Animas River flows, Navajo Reservoir inflow, travel time uncertainties, and other issues discussed below compounds the problem of meeting the Flow Recommendations.
3. ***Unanticipated precipitation events:*** Severe thunderstorms or rain events that occur on any tributaries that enter the San Juan River downstream from Navajo Dam affect the ability to meet the Flow Recommendations. These events cause flows to increase, and, depending on their duration, releases from Navajo Dam may be adjusted accordingly. Also, unanticipated flood inflows into Navajo Reservoir could require releases from the dam of up to 5,000 cfs at any time to avoid the occurrence of an uncontrolled spill.
4. ***Travel time:*** An adjustment in water releases from Navajo Dam takes about 3 days travel time to reach the Bluff gage in Utah.
5. ***Gage errors:*** These errors are inherent with all measuring equipment, and changing river channel and flow conditions (i.e., sand deposits and erosion) compound gage errors.
6. ***Contractual obligations:*** Reclamation's contract with the City of Farmington calls for 10 days notice to the extent possible prior to making changes in releases. This has informally been relaxed to 24 hours notice when increasing releases and 7 days when decreasing releases.
7. ***Maintenance needs:*** In the past few years, dam releases have been interrupted due to a variety of unforeseen events such as mechanical problems, repair of gates and other factors. In addition, regularly scheduled maintenance needs and unforeseen events may impact Reclamation's ability to make specific releases.

V. Alternatives Evaluation

Introduction

This section presents alternatives retained for detailed analysis. Section VI discusses alternatives considered but eliminated from detailed consideration. This section begins

with an explanation of the hydrology considerations taken into account during alternatives formulation and evaluation. A summary comparison of the alternatives considered against the evaluation criteria is presented in table II-2 and impacts associated with the retained alternatives are presented in table II-9 at the end of this chapter.

The alternatives described below were retained for further analysis.

- ☐ No Action Alternative (Historical Operation)
- ☐ 250/5000 Alternative (Flow Recommendations)
- ☐ 500/5000 Alternative

Four alternatives were dropped from consideration as viable alternatives. These alternatives were: (1) the 250 Variable/5000 Alternative, (2) 250/6000 Alternative, (3) 500/6000 Alternative, and (4) Decommissioning and Breaching Navajo Dam. The reasons these alternatives were dropped from further consideration are provided in the “Alternatives Considered but Eliminated” section of this chapter.

Hydrology Considerations

Determining viable alternatives for operating the dam to meet the Flow Recommendations criteria required modeling complex relationships, including fluctuating tributary inflow and flow depletions associated with multiple diversion and return flow points. A requirement of the modeling was the ability to assess water resources system responses over the long term.⁶

As noted earlier, a summary of depletions used in the hydrology model for each alternative is shown in table II-1.

⁶ RiverWare was the simulation model software selected by Reclamation and the Bureau of Indian Affairs (BIA) for use in the development of a hydrology model for the Basin to be used to evaluate the Flow Recommendations. The model has been used by Reclamation and the BIA in the Basin since 1998 in support of assessing the relationship between flow recommendations for endangered fish in the San Juan River and water development. For this DEIS, three model configurations were developed to simulate future conditions: the No Action Alternative; the 250/5000 Alternative (Flow Recommendations); and the 500/5000 Alternative. Reclamation believes that the current model version is the best available; substantial revisions to the current model are being evaluated and tested by the SJRBRIP Hydrology Committee. Reclamation does not expect that revisions to the model would affect its selection of a Preferred Alternative, though new information provided through updated modeling in the future will be considered as appropriate in Reclamation’s Navajo Dam operations.

Table II-2.—The alternatives arrayed by evaluation criteria

Criteria	No Action	250/5000	500/5000	250/Var 5000	250/6000	500/6000	Decommission/ Breach Dam
Minimizes adverse impacts to existing/future authorized water uses	No	Yes	In part	No	No	No	No
Levels of protection for Indian Trust Assets	Low	High	Moderate	Moderate	Low	Low	Low
Meets SJRB RIP Flow Recommendations	No	Yes	No	No	No	No	No
Meets various laws and policies (including Navajo Dam authorized purposes, ESA, State laws and interstate compacts)	Yes	Yes	Yes	Yes	No	No	No
Meets Corps flood control/channel criteria	Yes	Yes	Yes	Yes	No	No	No
Avoids impacts to diversions, water quality, erosion, fisheries, recreation, and others							

(Please see summary of impacts table at the end of this chapter)

Table II-3 summarizes the degree to which each alternative retained for further consideration and analysis meets the Flow Recommendations.

Figures II-2 and II-3 and tables II-3 through II-7 illustrate the hydrology and operation of the No Action, 250/5000, and 500/5000 Alternatives, displaying the elevation of the water surface in Navajo Reservoir and average monthly flows at Archuleta (just downstream from Navajo Dam) and at Bluff, Utah. These tables were also developed to show the frequency of various flows at Archuleta and Bluff. Table II-8 presents flows measured during the Summer Low Flow Test conducted in July 2001 under a 250 cfs release scenario.

Hydrology Model – No Action Alternative

The San Juan Basin hydrologic model was configured to simulate future conditions without meeting the Flow Recommendations by including all current depletions, all depletions that could occur without further Federal action (primarily exercise of some, but not all, State water rights not presently being used in Colorado and New Mexico), and all depletions from Federal projects included in the baseline for the 1991 ALP Project ESA consultation. Because the Flow Recommendations would not be met, it was assumed that the ALP Project, completion of NIIP, portions of the Jicarilla Apache Nation water rights settlement, and other water depletions (Florida and Mancos municipal and industrial [M&I] water contracts)—including the 3,000 acre-feet of unspecified minor depletions as allowed under various ESA consultations—would require reconsultation, so they were not included under this alternative. To simulate reservoir releases under the No Action Alternative, the model uses operation rules representing how the dam was operated, on average, from 1973 to 1991. The No Action Alternative depletions total about 667,000 acre-feet per year from the San Juan River. Depletions assumed for the No Action Alternative appear in the previously mentioned depletion table (table II-1).

Hydrology Model – 250/5000 and 500/5000 Alternatives

The model configuration for the two action alternatives is the same, only varying with minimum Navajo Reservoir releases. Minimum target releases are 250 cfs for the 250/5000 Alternative and 500 cfs for the 500/5000 Alternative. To analyze the effects to the water supply, the model was configured to simulate the condition of operating the Navajo Dam to meet the Flow Recommendations criteria and to satisfy existing depletions. The model was also configured to simulate all depletions that could occur without further Federal action (primarily exercise of some, but not all, State water rights not presently being used in Colorado and New Mexico), and all depletions which have received a favorable biological opinion from the Service. Such depletions include 57,100 acre-feet per year for the ALP

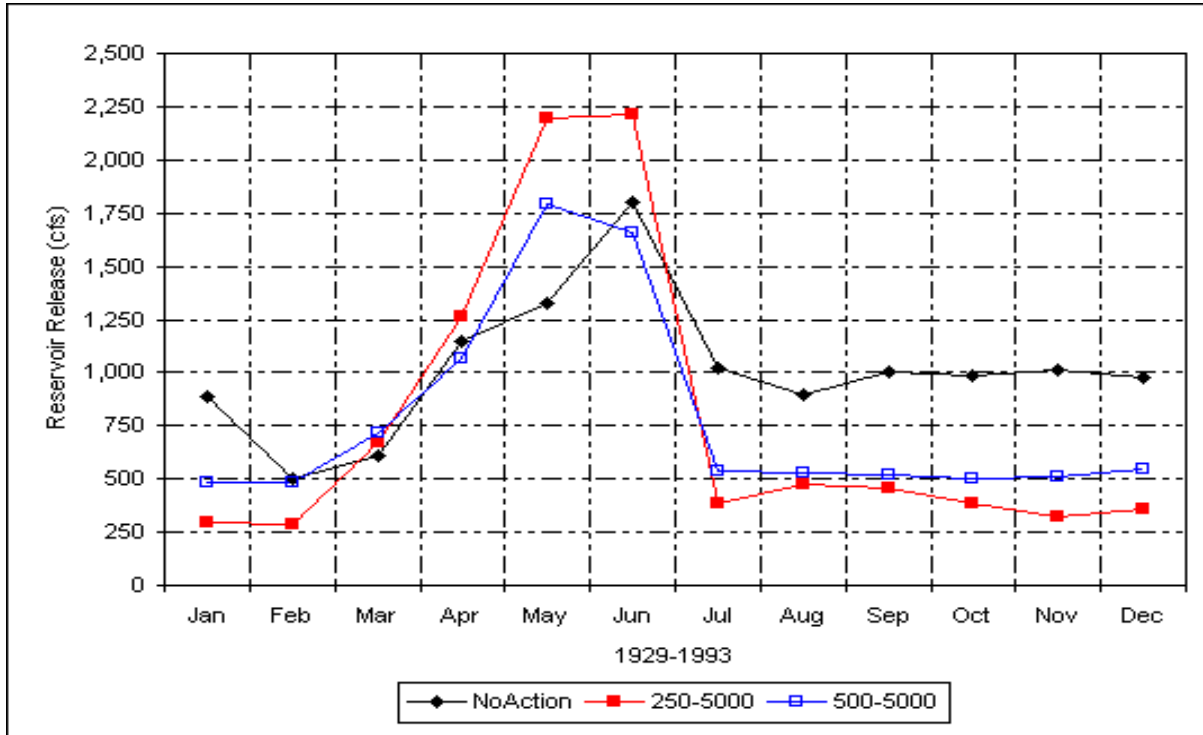


Figure II-2. – Navajo Reservoir average monthly release comparing three alternatives.

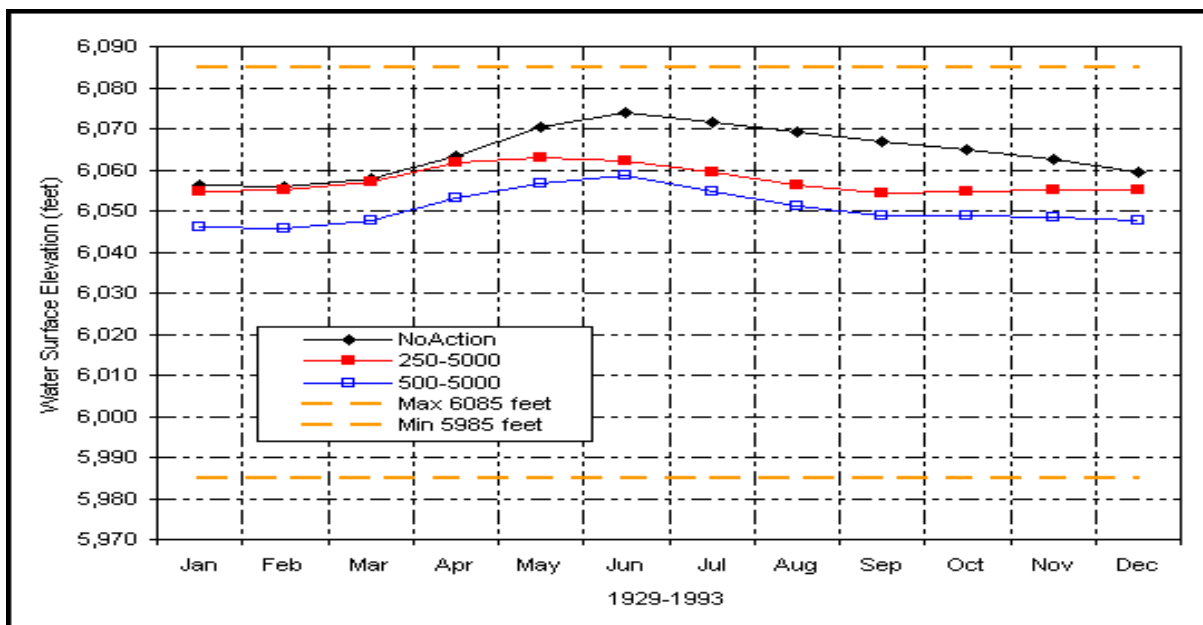


Figure II-3. – Monthly average water surface elevations for Navajo Reservoir projected for three Navajo Dam operating alternatives (1929-93 data).

Table II-4.—San Juan River flows at Archuleta monthly summary statistics for the
No Action, 250/5000, and 500/5000 Alternatives (1929 – 93 data)

	San Juan at Archuleta								
	No Action			250/5000			500/5000		
	Average monthly flows (cfs)			Average monthly flows (cfs)			Average monthly flows (cfs)		
Month	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum
October	984	3,791	500	388	1,010	250	501	957	0
November	1,015	3,126	500	321	1,554	250	507	1,189	0
December	978	1,782	500	360	1,617	250	544	1,780	0
January	887	1,290	500	296	433	250	486	500	0
February	500	500	500	287	444	250	488	500	0
March	606	4,929	500	672	5,000	250	715	4,250	500
April	1,144	5,000	500	1,260	5,000	250	1,063	4,750	500
May	1,323	5,000	500	2,195	5,000	250	1,795	5,000	500
June	1,798	5,000	500	2,215	3,937	250	1,660	3,749	500
July	1,022	4,590	500	386	1,476	250	538	1,454	227
August	898	3,465	500	471	1,104	250	531	1,081	0
September	1,004	4,339	500	459	1,027	250	517	1,004	0
Average	1,013	3,568	500	776	2,300	250	779	2,184	186
Maximum	1,798	5,000	500	2,215	5,000	250	1,795	5,000	500
Minimum	500	500	500	287	433	250	486	500	0

Note: Minimum flows of zero are shown under the 500/5000 Alternative because the reservoir is occasionally drawn down below the NIIP inlet works. In actuality, the reservoir inflows would be bypassed to meet downstream water uses.

Table II-5.—San Juan River flows at Bluff, Utah, monthly summary statistics for the
No Action, 250/5000, and 500/5000 Alternatives (1929 – 93 data)

	San Juan at Bluff								
	No Action			250/5000			500/5000		
	Average monthly flows (cfs)			Average monthly flows (cfs)			Average monthly flows (cfs)		
Month	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum
October	1,668	10,189	455	1,012	7,338	525	1,127	7,285	36
November	1,548	4,982	644	824	3,261	525	1,010	2,895	249
December	1,415	2,806	742	777	2,645	525	964	2,808	261
January	1,309	2,717	734	716	1,743	525	907	1,993	367
February	1,154	3,036	729	940	2,792	547	1,141	3,014	503
March	1,303	6,332	451	1,329	6,285	525	1,372	5,535	525
April	2,130	8,079	220	2,151	7,704	525	1,956	7,454	525
May	3,232	12,934	380	4,017	12,863	525	3,621	12,872	525
June	4,317	10,314	509	4,680	9,081	609	4,113	8,944	609
July	2,102	7,836	258	1,465	4,715	525	1,618	4,692	525
August	1,522	8,223	67	1,110	5,175	525	1,171	5,183	435
September	1,538	8,218	182	990	4,288	525	1,050	4,296	42
Average	1,936	7,139	448	1,668	5,657	534	1,671	5,581	384
Maximum	4,317	12,934	742	4,680	12,863	609	4,113	12,872	609
Minimum	1,154	2,717	67	716	1,743	525	907	1,993	36

Table II-6.—Seasonal frequency distribution of monthly Navajo Reservoir releases for the three alternatives (based on 1929 – 93 hydrology)

Release range (cfs)		Number of occurrences			Occurrences as percent		
		All months					
		No Action	250/5000	500/5000	No Action	250/5000	500/5000
0	249	0	0	15	0	0	2
249	251	0	222	0	0	28	0
251	350	0	191	0	0	24	0
350	499	0	144	0	0	18	0
499	501	345	3	593	44	0	76
501	1,000	185	103	93	24	13	12
1,000	2,500	196	38	24	25	5	3
2,500	5,000	54	79	55	7	10	7
Total number of months		780	780	780	100	98	100
		December through February					
		No Action	250/5000	500/5000	No Action	250/5000	500/5000
0	249	0	0	6	0	0	3
249	251	0	54	0	0	28	0
251	350	0	121	0	0	62	0
350	499	0	16	0	0	8	0
499	501	109	0	185	56	0	95
501	1,000	16	0	0	8	0	0
1,000	2,500	70	4	4	36	2	2
2,500	5,000	0	0	0	0	0	0
Total number of months		195	195	195	100	100	100
		March through November					
		No Action	250/5000	500/5000	No Action	250/5000	500/5000
0	249	0	0	9	0	0	2
249	251	0	168	0	0	29	0
251	350	0	70	0	0	12	0
350	499	0	128	0	0	22	0
499	501	236	3	408	40	1	70
501	1,000	169	103	93	29	18	16
1,000	2,500	126	34	20	22	6	3
2,500	5,000	54	79	55	9	14	9
Total number of months		585	585	585	100	102	100

Table II-7.—San Juan River at Bluff – distribution frequency of monthly flow 1929 – 93

Month	Percent of time mean monthly streamflow is less than 500 cfs			Percent of time mean monthly streamflow is between 500 and 800 cfs			Percent of time mean monthly streamflow is greater than 800 cfs		
	No Action	250/5000*	500/5000	No Action	250/5000	500/5000	No Action	250/5000	500/5000
January	0.0	0.0	3.1	6.2	78.5	26.2	93.8	21.5	70.8
February	0.0	0.0	0.0	12.3	49.2	12.3	87.7	50.8	87.7
March	3.1	0.0	0.0	23.1	55.4	29.2	73.8	44.6	70.8
April	12.3	0.0	0.0	21.5	44.6	40.0	66.2	55.4	60.0
May	1.5	0.0	0.0	6.2	9.2	9.2	92.3	90.8	90.8
June	0.0	0.0	0.0	1.5	3.1	1.5	98.5	96.9	98.5
July	4.6	0.0	0.0	10.8	18.5	13.8	84.6	81.5	86.2
August	6.2	0.0	1.5	15.4	40.0	36.9	78.5	60.0	61.5
September	12.3	0.0	3.1	10.8	53.8	41.5	76.9	46.2	55.4
October	3.1	0.0	3.1	15.4	66.2	43.1	81.5	33.8	53.8
November	0.0	0.0	3.1	9.2	67.7	18.5	90.8	32.3	78.5
December	0.0	0.0	3.1	7.7	76.9	26.2	92.3	23.1	70.8

Note: While the goal is to remain above 500 cfs, it is anticipated that flows will occasionally fall below 500 cfs.

Table II-8.—Summary of streamflows measured during the 2001 Summer Low Flow Test

Location	River Mile	Average Flow (cfs)
San Juan River at Soaring Eagle Lodge (below Citizens Ditch)	216.4	132.7
San Juan River above Turley Inlet Channel	214.4	131.4
San Juan River below Hammond Diversion	209.1	63.0
San Juan River below Blanco Bridge	207.0	87.7
San Juan River above Bloomfield Bridge	195.8	130.0
San Juan River below Bloomfield Sewer discharge	194.8	131.1
San Juan River below Lees Acre Bridge	188.5	185.7
San Juan River 1/4 mile above Animas River confluence	181.4	218.7

Project, 120,600 acre-feet per year for completion of NIIP, and 3,000 acre-feet per year for unspecified minor depletions. The action alternatives depletions total about 850,000 acre-feet per year. The overall technical configuration of the model is shown in Volume II.

Alternatives Retained for Further Consideration

No Action Alternative

Because it does not address the Flow Recommendations, it is likely that implementing the No Action Alternative would adversely affect downstream endangered fish habitat and existing and future water development. However, this alternative would help maintain or enhance the downstream trout fishery and river rafting by moderating flow fluctuations.

Selecting the No Action Alternative would require reconsultation with the Service under the ESA for the ALP Project, which could place the completion of the project at risk. Consequently, that portion of the Ute Mountain Ute and Southern Ute Indian Tribes' water right settlement provided under the ALP Project might not be met.

Selecting this alternative could put the completion of NIIP at risk and would leave the NIIP (Blocks 1-6) depletion limited to 133,000 acre-feet per year. The approximately 16,400 acre-feet per year that was transferred from Hogback and Fruitland to NIIP in the 1999 consultation would remain available for use on the NIIP⁷. This could limit the development of NIIP to about 54,500 acres, or 56,130 acres short of the full project acreage.

The Jicarilla Apache Nation's third-party contract with PNM for the San Juan Power Plant Diversion of 16,200 acre-feet and other Navajo Reservoir Supply Contracts serviced by the Jicarilla Apache Nation (840 acre-feet) would also be jeopardized.

In addition, the current depletion allowance of 3,000 acre-feet for small unspecified water uses could no longer be valid and each minor use would need a separate ESA consultation. Future water delivery and associated renewal of existing water contracts from Lemon, Vallecito, and Jackson Gulch Reservoirs and the San Juan-Chama Project also could be at risk since there have been no ESA consultations on the operations of these projects.

⁷ The depletion of a completed NIIP is 270,000 acre-feet per year, a difference of 137,000 acre-feet per year between pre-consultation depletions on Blocks 1-6 and full NIIP depletions that would occur on Blocks 1-11. Annual equilibrium depletion is 270,000 acre-feet; 10,600 acre-feet goes into groundwater storage until equilibrium is reached between groundwater storage and return flow, for a net impact to the San Juan River of 280,600 acre-feet during project build-out and start of NIIP Blocks 7-11.

250/5000 Alternative (Flow Recommendations)

Operations under this alternative would best meet the purpose of and need for the proposed action. It would allow water projects that have completed ESA consultations and NEPA compliance—including NIIP completion, the ALP Project, the Jicarilla Apache contract with PNM, and 3,000 acre-feet for minor unspecified depletions—to proceed, and would meet the Flow Recommendations (see the summary statistics of meeting Flow Recommendations criteria, table II-3). Since this alternative meets Flow Recommendations, it also removes the risk of impact to the other water uses listed under the No Action Alternative.

Reclamation would modify Navajo Dam operations to provide sufficient releases of water at times, quantities, and durations necessary to assist in conserving endangered fish and their designated critical habitat. Reclamation would maintain the authorized purposes of the Navajo Unit, enabling water development to occur in compliance with applicable laws, compacts, decrees, and Indian trust responsibilities.

Under this alternative, releases would range from 250 cfs to 5,000 cfs. The spring peak release would meet the Flow Recommendations criteria. The summer, fall, and winter releases as low as 250 cfs are intended to meet the Flow Recommendations downstream of Farmington and to provide water storage in Navajo Reservoir. These releases would also help maintain a minimum 500 cfs flow downstream of Bluff, Utah, benefitting river rafting⁸. All releases would be made within the operational limitations/constraints of Navajo Dam.

Some flexibility in reservoir releases already exists because water committed for present or future development is not currently used. This may be a significant amount of water in any given year and would be released downstream until used for development. The release of this water could be incorporated into operations to augment a 250 cfs minimum release while maintaining a target flow of at least 500 cfs downstream of Farmington⁹. It also could be released to extend the duration of the spring peak release. The regulation of this water

⁸ Flow Recommendations call for the average of two of four gages (Farmington, Shiprock, Four Corners, Bluff) to be 500 cfs; thus, flows are not always above 500 cfs at all locations. However, in July 2002, the SJRBRIP Biology Committee wrote a discussion suggesting that base flows be monitored in a different manner: "Use the lesser of the average of Bluff, Four Corners and Shiprock and the average of Farmington, Shiprock and Four Corners. If one or more of the gages is missing or is obviously providing incorrect data, use the remaining gages in the set. Extreme conditions (low or high flows) identified by the Bureau of Reclamation will be handled on a case-by-case basis with recommendations of the Biology Committee." Reclamation is currently evaluating this method of monitoring.

⁹ The SJRBRIP Biology Committee acknowledged that some flexibility exists in meeting the upper limit of 1,000 cfs during the irrigation season. The Biology Committee indicated that during the irrigation season (March through October) "it may not be effective or necessary to lower releases below 500 cfs until water use in the basin increases to the point that the water is needed to meet runoff period recommendations. This flexibility is extended only to the irrigation season as defined. . . and only until water development reaches the level that additional water is needed for Spring releases." (February 21, 2002, memorandum from Biology Committee to Reclamation).

would be determined through the Navajo Unit operation meetings and discussions with the Service. One likely scenario is to regulate this water to maintain higher late spring and summer releases to the river to provide recreation, hydropower, water quality, fish and wildlife, and other benefits. Unusually high inflows (other than those associated with spring runoff) resulting in very high reservoir elevations would be released as a spike flow, if necessary to avoid an uncontrolled spill under this alternative.

500/5000 Alternative

During the public scoping process, many people requested that minimum releases not be reduced below 500 cfs. This alternative was included to reduce potential impacts on downstream water users' ability to take water at their diversion structures and to downstream recreation users (trout fishery and rafting) by maintaining higher minimum releases than those under the 250/5000 Alternative.

Because Flow Recommendations are not fully met by this alternative, reconsultation under ESA on the ALP Project, NIIP completion, and 3,000 acre-feet of minor unspecified depletions would be required. In addition, Navajo Reservoir would infrequently (less than 1 percent of the time) be drawn down below the NIIP inlet works, thus interfering with irrigation deliveries to the NIIP. Further, maintaining the minimum release at 500 cfs limits the ability to develop water and results in spring peak releases of lesser duration and frequency. A minimum release of 500 cfs also limits the ability to meet Flow Recommendations below Farmington.

Even though this alternative would not fully meet the Flow Recommendations (see the summary statistics of meeting Flow Recommendations criteria, table II-3), the purpose and need outlined in this DEIS, or diversion demands from the Navajo Reservoir water supply, it was retained for analysis because of substantial public interest and concern.

VI. Alternatives Considered but Eliminated

During the alternatives formulation and evaluation process, some of the alternatives were found to have serious flaws either in meeting the project purpose and need or in technical/physical constraints. Accordingly, they were eliminated from further consideration and were not carried over for full evaluation.

250 Variable/5000 Alternative

The 250 Variable/5000 Alternative was developed with the intent to minimize potential impacts on downstream water users' ability to take water at their diversion structures. In addition, it would attempt to minimize impacts to downstream recreation users (trout

fishing and rafting) by maintaining higher minimum releases during certain critical times of the year than does the 250/5000 Alternative. However, it would result in insufficient reservoir storage to provide releases to meet spring peak flow criteria.

Under the Proposed Federal Action section of the NOI, Reclamation stated the following:

Reclamation proposes to prepare a DEIS which will describe the effects of operating the Unit to implement the flow recommendations, or reasonable alternatives, as contained in the recommendation from the Program's Biological Committee resulting from consultation under the ESA.

To further this effort, Reclamation met with the Service on August 8, 2001, in Albuquerque, New Mexico. The meeting focused on discussing the possibility of implementing the 250 Variable/5000 Alternative as a reasonable alternative to operating Navajo Dam to more fully meet the Flow Recommendations. During the course of this discussion, it was determined that the Flow Recommendations contain flexibility, at least in the short term, that might allow for operations similar to those proposed in the 250 Variable/5000 Alternative. Therefore, this alternative was eliminated because it did not meet the Flow Recommendations.

250/6000 Alternative

This alternative was considered because it was modeled and discussed in the Flow Recommendations. However, studies completed by the Corps and Reclamation during the summer of 1998 demonstrated that a maximum release of 6,000 cfs is not feasible without performing major structural modifications to the dam's outlet works and channel and diversion improvements from the dam to the Animas River confluence.

As noted earlier, the Corps has determined that the current safe channel capacity for this reach is 5,000 cfs. Further, alternatives with the 6,000-cfs maximum release reduce the active storage of the reservoir to a point where, during extended droughts, releases to NIIP could not be made.

500/6000 Alternative

This alternative was considered as a way to reduce potential impacts on downstream water users' ability to take water at their diversion structures by providing a higher minimum flow release of 500 cfs.

In addition, it attempts to minimize impacts to downstream recreation (trout fishery and rafting) by maintaining higher minimum releases during certain critical times of the year

than does the 250/5000 Alternative. However, it has the same limitations as the 250/6000 Alternative and also does not fully meet the Flow Recommendations. The 6,000-cfs release also exceeds the channel capacity, as discussed under the 250/6000 Alternative.

Decommission and Breach Navajo Dam

This alternative largely meets the conditions of a natural hydrograph, and removal of the dam would provide the endangered fish with access to the portion of the San Juan River now inundated by Navajo Reservoir, as long as fish passage is provided throughout the river. Although large spring peaks would be provided most years, low flows during the irrigation season would still be impacted by downstream diversions that would result in low flows substantially below 500 cfs downstream of Farmington. Therefore, this alternative does not meet the Flow Recommendations.

This alternative is considered unreasonable and impractical because it does not meet all the elements of the purpose and need for the proposed action and would not support maintaining the authorized purposes of the Navajo Unit. It would result in loss of reservoir storage needed to allow contract water deliveries to the San Juan-Chama Project, the NIIP, and other contractors, and would make it extraordinarily difficult, if not impossible, for the States of New Mexico and Colorado to fully utilize their consumptive use apportionments under the Upper Colorado River Basin Compact. It also could precipitate expensive litigation of Indian versus non-Indian water rights in both States. In addition, this alternative would result in the loss of the following benefits provided by Navajo Dam and Reservoir: downstream flood control, reservoir and tailwater fisheries, reservoir and downstream recreation, and hydropower generation. The concept of decommissioning or removing the dam is beyond the scope of the proposed action.

VII. Preferred Alternative

After conclusion of a detailed analysis, Reclamation has selected the 250/5000 Alternative as the Preferred Alternative. This alternative best meets the purpose of and need for the Federal action as defined in chapter I (the 250/5000 Alternative is referenced in subsequent chapters of this DEIS as (Flow Recommendations) (Preferred Alternative)).

At the present time, mitigation measures are not included in the Preferred Alternative. Potential measures to mitigate adverse impacts to fish and wildlife and other resources with statutory requirements to consider mitigation are presented in chapters III and IV.

Table II-9 provides a summary of the impacts of the Preferred Alternative and the 500/5000 Alternative as compared to the No Action Alternative.

Future Water Development

It is intended for the Preferred Alternative to meet the Flow Recommendations, thereby complying with ESA for those water development projects' depletions (including some Indian trust water rights) in the depletion table. These projects and depletions are tabulated in table II-1.

The Preferred Alternative provides for significantly more depletions than does the No Action Alternative. The Preferred Alternative also does not preclude depletions beyond those shown in the depletion table; additional evaluation, NEPA compliance, and ESA consultation would be necessary for any depletions beyond these, if Federal action is required. The SJRBRIP has developed principles¹⁰ that explain and outline the process under which additional water projects and depletions will be evaluated, as described below:

The SJRBRIP will produce a list of actions defined in a long-range plan that can be implemented to assist in the recovery of the endangered fish. When ESA consultation is initiated on a new water depletion, the Service will determine if progress toward recovery has been sufficient for the program to serve as a reasonable and prudent alternative or measure. The Service will also consider whether the probable success of the SJRBRIP is compromised as a result of a specified depletion or the cumulative effects of depletions. The Service will assess the sufficiency of program actions in proportion to the potential impacts—that is, the smaller the impact of the action, the lower the level of actions by the SJRBRIP or others needed to avoid jeopardy and/or destruction or adverse modification of critical habitat. The Service will determine whether progress by the SJRBRIP is sufficient to provide a reasonable and prudent alternative or measure based on the following factors:

- (1) Actions that will result in a measurable positive fish population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction
- (2) Status of fish populations
- (3) Adequacy of flows
- (4) Magnitude of the impacts of the activities

¹⁰ *Principles for Conducting ESA Section 7 Consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the San Juan River Basin* (adopted by the Coordination Committee, SJRBRIP, June 19, 2002).

If the Service finds that SJRBRIP and other efforts are sufficient, the biological opinions will conclude these are reasonable and prudent alternatives (RPAs) to jeopardizing endangered fishes. If the Service finds they are not sufficient, the biological opinion will be written to identify actions to avoid jeopardy by identifying an RPA, or a jeopardy opinion would be rendered.

Table II-9—Summary comparison of alternatives retained for further analysis

Resource	No Action Alternative	250/5000 (Flow Recommendations) Alternative	500/5000 Alternative
Navajo Reservoir operations and content	Reservoir operated for flood control and existing uses; average July content 1.52 million acre-feet.	Reservoir operated for flood control, endangered fish, full NIIP water supply; average July content 1.35 million acre-feet.	Reservoir operated for flood control and endangered fish, potential shortage to NIIP water supply; average July content 1.30 million acre-feet.
San Juan River monthly flows at Archuleta (near dam)	Minimum flow 500 cfs; Average annual flow of 1,015 cfs; average July flow 1,050 cfs; average January flow 880 cfs.	Minimum flow 250 cfs; Average annual flow of 775 cfs; average July flow 385 cfs; average January flow 300 cfs	Minimum flow 500 cfs; Average annual flow of 780 cfs; average July flow 540 cfs; average January flow 500 cfs.
San Juan River monthly flows at Bluff, Utah	Minimum flow 65 cfs; Average annual flow of 1,900 cfs; average June flow 4,250 cfs; average August flow 1,570 cfs.	Minimum flow 500 cfs; Average annual flow of 1,670 cfs; average June flow 4,680 cfs; average August flow 1,110 cfs.	Minimum flow <100 cfs when reservoir storage exhausted; average annual flow of 1,670 cfs; average June flow 4,110 cfs; average August flow 1,170 cfs.
Water uses and resources	Water supply adequate to meet existing uses; future water uses including NIIP completion and ALP Project assumed not to occur.	Water supply adequate to meet existing uses; completion of NIIP and ALP Project would occur. Best opportunity to accomplish future water development.	Water supply adequate to meet existing uses with possible additional shortages in dry years; completion of NIIP and ALP Project included with possible shortages.
Indian Trust Assets/ Environmental Justice	Two types of ITA's potentially affected—water uses and cultural resources on trust lands. Least opportunity for development of water uses.	Two types of ITA's potentially affected – water uses and cultural resources on trust lands. Positive impacts to all Tribes by protecting water development that has ESA and NEPA compliance—allows best possibility for future water development.	Two types of ITA's potentially affected—water uses and cultural resources on trust lands. Shortages to water projects would occur and better chance for future water development than No Action.
Trout fishery	Maintains better downstream trout fishery than action alternatives	Habitat reduced average of 34 percent in special regulation waters when flows drop from 500 to 250 cfs. Physical habitat and water quality problems projected to be significant downstream from Citizens Ditch.	Maintenance of 500 cfs maintains existing trout fishery, although water shortage years may have adverse habitat impacts.

Table II-9—Summary comparison of alternatives retained for further analysis (continued)

Resource	No Action Alternative	250/5000 (Flow Recommendations) Alternative	500/5000 Alternative
Trout fishery recreation	Provides more recreation opportunities than action alternatives.	Reduction in trout fishery results in lower quality and/or quantity of recreation associated with trout fishing.	Recreation maintained, very infrequent water-short years have adverse effects on quality and/or quantity.
Native fisheries (e.g., roundtail chub, flannelmouth and bluehead suckers, etc.)	Has greater adverse impact on native fishes than action alternatives.	Reduced habitat in the river reach between the Hammond Diversion and Farmington; habitat improvement downstream from Farmington due to more natural hydrograph.	Some habitat improvement downstream from Farmington due to more natural hydrograph.
Rafting recreation downstream from Farmington	Overall flow regime beneficial; however, periods of flow below 500 cfs adversely affect rafting.	Overall quality of flows for rafting declines; however, attempt to maintain 500 cfs minimum raftable flows.	Overall quality of flows for rafting declines; however, attempt to maintain 500 cfs minimum raftable flows.
Reservoir recreation	Less impact than action alternatives.	Generally recreation levels maintained; reservoir drawdown adversely affects quality of recreation in dry periods.	Generally recreation levels maintained; reservoir drawdown adversely affects quality of recreation in dry periods.
Reservoir fishery	Less impact to reservoir fishery than action alternatives.	Minor adverse effects to reservoir fishery due to increased reservoir drawdowns.	Moderate adverse effects to reservoir fishery due to increased reservoir drawdowns.
Hydropower	Existing hydropower operations by City of Farmington at Navajo Dam would continue.	Reduced annual energy production. Annual hydropower replacement cost up to \$7 million.	Reduced annual energy production. Annual hydropower replacement cost up to \$3.2 million.
Diversion structures	Existing diversions protected by flood control operations and 500 cfs minimum releases from dam.	Some existing diversions need additional operation and maintenance to handle high spring releases and lower summer minimums.	Some existing diversions need additional operation and maintenance to handle high spring releases.

Table II-9—Summary comparison of alternatives retained for further analysis (continued)

Resource	No Action Alternative	250/5000 (Flow Recommendations) Alternative	500/5000 Alternative
River water quality	Existing conditions continue or improve due to water treatment and erosion control advances.	Dilution of pollutants reduced when minimum releases occurring; additional dilution during high releases. Improved channel maintenance.	Similar to existing conditions although dry year shortages may lead to increased water quality issues. Improved channel maintenance.
Reservoir water quality	Existing conditions continue	Existing conditions continue	Existing conditions continue
Socioeconomics	Adverse impacts occur as water development, including completion of NIIP and ALP, is detrimentally affected. Recreation economy maintained.	Adverse impacts on trout fishery economy and hydropower; economic benefits associated with water development occur.	Economic benefits associated with water development occur, although reduced due to water shortages. Recreation economy maintained.
Special Status species	Flow recommendations to conserve endangered fish not met; no significant effect on other endangered species.	Flow recommendations to conserve endangered fish met; no significant effect on other endangered species.	Flow recommendations to conserve endangered fish partially met; no significant effect on other endangered species.
River vegetation and wildlife downstream from dam	Minimal impacts to riparian vegetation recruitment due to reduced spring releases. Inconsequential effects on existing riparian vegetation and associated wildlife habitat.	Adverse impacts to vegetation and associated wildlife habitat along first 7 miles of river downstream from dam due to lower minimum flows; high spring releases may benefit cottonwood regeneration and reduce human encroachment into riparian areas.	Inconsequential effects on existing riparian vegetation and associated wildlife habitat. High spring releases may benefit cottonwood regeneration and reduce human encroachment into riparian areas.
Reservoir vegetation and wildlife	Less impact to existing wetland and riparian vegetation and associated wildlife habitat as compared to action alternatives.	Minimal additional impacts to wetland and riparian vegetation and associated wildlife habitat associated with greater reservoir fluctuations.	Moderate additional impacts to wetland and riparian vegetation and related wildlife habitat associated with greater reservoir fluctuations.

Table II-9—Summary comparison of alternatives retained for further analysis (continued)

Resource	No Action Alternative	250/5000 (Flow Recommendations) Alternative	500/5000 Alternative
Land use	Current land uses not affected by reservoir operations. Possibly no future development of NIIP lands.	56,130 acres of additional irrigation land developed under NIIP.	Possible reduction of full NIIP development.
Cultural resources	Reservoir fluctuations continue to impact cultural resources in reservoir basin.	Reservoir fluctuations impact cultural resources; impact less than No Action but greater than 500/5000 Alternative.	Reservoir fluctuations impact cultural resources; impact between that of No Action and 250/5000 Alternatives.
Flood control and erosion	Flood control operations of Navajo Dam met; maximum releases limited to 5,000 cfs.	Flood control operations of Navajo Dam met; maximum releases limited to 5,000 cfs; increased frequency of releases of 5,000 cfs would cause bank erosion until river stabilized itself or banks stabilized.	Flood control operations of Navajo Dam met; maximum releases limited to 5,000 cfs; increased frequency of releases of 5,000 cfs would cause bank erosion until river stabilized itself or banks stabilized.
Operation, maintenance and safety of dams	Operations would be within designed capability of Navajo Dam.	Operations would be within designed capability of Navajo Dam. Increased monitoring of gaging stations and more frequent release changes required.	Operations would be within designed capability of Navajo Dam. Increased monitoring of gaging stations and more frequent release changes required.
Hazardous materials	No impacts.	No impacts.	No Impacts.
Geology and soils	No impacts.	No impacts.	No impacts.
Air quality and noise	No impacts.	Increased dust due to lower reservoir levels exposing more land.	Increased dust due to lower reservoir levels exposing more land.

¹ The table presents long-term impacts. Until further water development occurs in the Basin, additional water would be available to reduce impacts to various resources including irrigation, trout fishery, and recreation; this interim water would diminish as development occurs.